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## The Flora of the Desert of Atacama.

BY THOS. MORONG.

Under the old geographical limits, before Chile had appropriated as a war indemnity the whole of Bolivia's seacoast and three degrees of Peruvian soil, the desert of Atacama was figured as extending from Coquimbo on the south to Bolivia on the north and eastward from the Pacific Ocean to the Andes, being nearly coincident with the province of the same name in Chile. So far, however, as the natural features are concerned, the name might well be applied to the entire region lying between Valparaiso and Ecuador, for it is all a desert broken only by lofty mountain peaks and deep valleys, the beds of ancient rivers, and watered here and there by scanty streams derived from the melting of the snows upon the high Cordilleras. The water from this source is carefully husbanded by the inhabitants of the valleys, and used in irrigation for agricultural purposes. Very little of it goes to produce the flora referred to in this article, by far the greater part of which belongs exclusively to the desert proper.

It seems like a contradiction in terms to speak of a *desert* vegetation, and especially one upon a territory so bleak and desolate as the Atacama, which is distinguished by the number of its hideously barren hills of rock and its sandy wastes. And yet this desert bears a flora quite extensive in the number of its species and very peculiar and interesting in its character. Over 500 species of plants have been gathered within its borders, and probably as many more might be detected upon a close research. One naturally wonders by what chance such a flora can be brought into existence and how it can live after being once started. In explanation it must be said that this region is not absolutely rainless, although it is nearly so. There is an occasional winter rain, or rarely two or three showers in the course of a winter, occurring at long intervals. Generally such rains are barely enough to moisten the ground, but that little is sufficient to cause the seeds, which are lying dormant in the sand or the bulbs beneath the ground, to germinate. Once up the seedling is kept alive by the dews which fall nightly upon the earth, and by the

mists that hang around the hills every morning in the winter and spring-time. In this way these growths obtain moisture enough to enable them to reach maturity. Besides this the Atacaman plants have acquired several peculiarities which admirably adapt them to their conditions of life. One of these lies in the power of the seeds to live for many years in the dry sand without germinating. They have been known to retain their vitality for ten years and then to sprout at the touch of rain.

I suspected from appearances that a special weather protection existed in many or all of these seeds, and Dr. Gregory of Barnard College, who has, at my request, kindly examined microscopic sections of a number of species, confirms my suspicions so far as these particular species are concerned. The seeds in every case proved to have unusually thick walls and a copious supply of albumen around the embryo. In one instance (*Pintoa*) she reports that the "seed coats are heavy, the outer one having peculiar shaped cells which turn to mucilage on coming into contact with water." Another (a *Tristagma*) has "copious albumen and the outer walls are thickened and turned in color to a dark brown, making an extremely hard coat." *Calandrinia* seeds presented a coating "somewhat heavy, but with a peculiar readiness to break on contact with water." *Cristaria* has an integument of several layers which together make a thick wall, and the interior albuminous. *Viola* shows in the seed coat a contrivance similar to that of *Pintoa*, with more or less of albumen in the interior.

While seeds are thus fortified against a protracted drought, tubers and bulbs are equally well equipped by the large amount of water or milk which they store up. I found many of the bulbs that I collected so full of juice that I could squeeze it out in a stream by hand.

Another peculiarity of the herbaceous flora, evidently acquired, is the early age at which the plants begin to flower and fructify. As if aware that they have only an ephemeral life and that what they have to do must be done quickly, they are scarcely above ground before they put forth blossoms. Many species may be seen in flower when hardly an inch in height, and which go on flowering until they reach the stature of two or three feet—if they can survive so long. I was continually deceived by this

habit, naturally supposing that these wee things must be different in species from plants that I had seen elsewhere only as tall and robust when in flower. A little more experience, however, convinced me that these Liliputians were merely taking time by the forelock.

Still another adaptation, excited apparently by the conditions under which they exist, is the extraordinary number of seeds formed by many plants and scattered over the soil in which they grow. This habit is not confined to species which usually yield great numbers of seeds, but seems common to all the desert flora. Thus a little violet which seldom attains a height of three inches, common about Caldera, often exhibits from thirty to forty pods full of seeds upon a single plant. When one looks down upon it, he can see only a mass of yellow flowers and fruit pods. I might mention many other plants in which the same peculiarity is noticeable.

One other apparent adaptation deserves mention. It is said that a majority of the desert plants are shrubs, or at least, are suffruticose, and this accords with my own observation. I found that such growths are in the habit of shedding their leaves in the summer instead of winter, thus reversing the ordinary process of nature. By this means they reduce their vital expenditure to a minimum at a season when they need to husband their utmost strength in order to resist long and continued dryness. This leaves them free to exert their full powers at a period when they are most likely to imbibe the revivifying moisture. Aided in this by their thick, long and knotty roots and close, non-evaporating bark, these shrubs, which seem to be nothing but dead stocks in the summer, can withstand even several years of drought.

After premising this much concerning the locality and the flora in general, I will give some account of my own explorations in the Desert of Atacama. It was my good fortune to reach Caldera, the sea-port of Copiapo, in the month of September last, which is early spring time in that latitude. It also happened to be a year when this rare flora had sprung up, a thing which I understood from residents had not occurred for several years previously. A single rain had fallen in the month of June, and at the time of my visit the plants were in full bloom. Had the

visit been made two months later, I was assured that not a flower would have been in sight.

The sandy slopes around Caldera, especially where the soil was shaded by rocks, bore quite a number of species, the most common of which was a dusty-looking composite (*Encelia tomentosa*, Walp.) with pale yellow ligulate flowers, known popularly as *Corona de fraile*, so-called from the convex mass of disk flowers which remind one of the shaven crown of a priest's head. Several other species of Compositæ also occur in this vicinity, such as *Polyachyrus fuscus*, Walp., a tomentose plant with much dissected leaves and showy, oblong, close-flowered heads of purple florets, *Chuquiraga acicularis*, Don., a half shrubby, bushy, and very forbidding plant, which has crowded spine-tipped leaves, and small heads with yellow spinescent scales, and a *Closia*, the flowers and odor of which put one in mind of our Chamomile. Two delicate *Cuscutas* twined about small plants on the open sand, one of them with silk-like stems and white flowers, and the other with masses of purple blossoms. Both of these are popularly named "*Cabellos de angel*," Angel's hair. Lying close against the sides of rocks was a queer Asclepiadaceous shrub known as *Cynoctonum viride*, Phil. The stock which manages to survive the summer is short and stumpy, with a thick head like an old pollard willow, from which it sends out new green shoots whenever the winter rain falls. Out upon the open sand one frequently meets with *Frankenia aspera*, Ph., throwing its dark colored branches over the ground, *Scilla triflora*, Ph., a bulbous plant with erect stems and racemes of pretty white flowers, and *Oenothera Coquimbensis*, Spach., one of the species noticeable for commencing to flower when not much larger than a needle, and continuing the process till it is two feet in height. Here too I collected several species of *Eritrichium*, *Heliotropium*, *Osteocarpus*, *Tetragonia*, and other plants which there is no room to mention.

After rambling over the Caldera sands till my feet grew weary, I made a number of expeditions on horseback and by rail to more distant points. One of these was to a gorge among the hills seven or eight miles north of Caldera, known to the people as the "*Quebrada* (ravine) *de los leones*." I was informed that the name

owed its origin to the fact that in former years a number of pumas or Chileno lions had been killed in the ravine. Here also lovers of the chase had often come to hunt the guanaco, an animal somewhat smaller than the llama, but belonging to the same family. Neither lion nor guanaco, however, appeared to welcome me to his lair, a circumstance which I did not much regret. On the way to this mountain defile we rode along the sea-shore for several miles, and then struck inland over a wide track of loose, shifting sand into which our horses sank nearly half way to the knees, and which is continually blown about by the wind. Along this route I gathered a number of interesting plants. Among them was a *Calandrinia*, the common name of which is "*Pata de guanaco*," or guanaco's foot, so-called from the fancied resemblance of the shape of its leaves to the hoof of the guanaco. This elegant flower throws up a tall, branching stem, each branch bearing on long naked peduncles several large and brilliant purple blossoms, a conspicuous object upon the desert. Another species, or perhaps only a variety of this, much smaller in size, grows near the sea-shore, having a bright yellow corolla. In clumps around which the sand is often heaped in ridges as if against a wall occurred an odd-looking, yellow-flowered shrub of the Apocynæ, (*Skytanthus acutus*, Meyen), popularly named "*Cuerno de cabra*," or Goat's horn, from the singular habit which its long, pointed follicles have of twisting themselves into the shape of a pair of goat's horns. The resemblance is so exact, that every one calls them by that name at first sight. In similar situations is found an *Ephedra*, vulgarly "*Pingo-pingo*," the naked sharp-pronged stems of which seem just in place in such a region. We frequently rode through mounds of sand in which clumps of these two shrubs were completely buried.

Farther along the sand was firmer, but attended by a new danger to the horseman. A small lizard, of a livid color and some six or eight inches in length, the only animal that we encountered in our excursion makes its burrow in these inhospitable wastes. As the animal is quite gregarious in its habits, we often came upon spaces entirely honeycombed by scores of these little creatures. Riding incautiously upon such ground our horses would suddenly sink over the fetlock into these burrows

and stumble badly, running great risk of breaking a limb or throwing the riders over their heads. About such spots, however, some charming flowers were obtained. One of these was *Cruckshanksia Geisseana*, Ph., an elegant plant, covered with masses of showy yellow flowers, very fragrant, and remarkable for its involucre, long-stiped sepals. Another was a Bignoniaceous species, named *Argylia*, which has long, finely dissected radical leaves, and a scape ten or twelve inches high, having a large cluster of yellow trumpet-shaped flowers at the summit. Still another plant of much interest, growing in clumps, was an Umbellifer called *Eremocharis*, a tall almost naked stemmed under-shrub, with long internodes and curious subbipinnatifid leaves, which emit the odor of apples when first plucked or bruised.

Along this route also grew some of the most peculiar Cacti that I had ever seen. The most noticeable of all belongs to a genus created by Philippi, and is, I believe, confined to this desert, named *Eulychnia breviflora*. It throws up from a cluster of roots numerous columnar stalks about as large in diameter as a man's arm, and armed with innumerable long, unequal, needle-like spines. The flower is on the summit of the stalk, not unlike a large cup in aspect, the lower part of which is covered with crinkly velvet hairs of a lavender hue, above which rises a single row of stiff white petals, including a host of delicate stamens. Another Cactus of the melon variety, not over eight inches high, and not unlike a pineapple in shape, has its spines twisted about the stem so that they resemble a bird's nest, inside of which the small red flowers hide like eggs.

When we reached the Quebrada, we found it to be a very rocky ravine running up the hillside between two eminences, along the slopes of which were heaped many boulders, as if carried down there by floods in former ages. Among the rocks trickled a small stream of water, which soon lost itself in the sand at the bottom of the ravine. As the day was quite warm, and I was heated and tired with my long ride, it sounded very pleasant to hear the gurgling of water, and as I have often done on such occasions in the White Mountains, I hastened to scoop up a drink in the hollow of my hand. My companion, a native Chileno, laughed at my motions, and with good reason, for I had





beautiful was the day and so pleasant the ride by the sparkling blue waters of the Pacific, that even if there had been no botanical interest in the trip, I should have been more than satisfied. I returned, however, with my portfolio full of specimens of unique interest to the botanist. Before reaching the seashore or upon its borders, we passed through clumps of various species of *Nolana*, *Dolia*, *Phaca*, *Malesherbsia*, *Suaeda* and other plants which I will not attempt to describe. One species, however, deserves mention on account of its eminent fitness for a desert life, and that is an *Euphorbia*, named *E. Copiapina* by Philippi. It has a multitude of short stems which rise directly from a huge underground tuber, and lie in a circle upon the ground. The stems, leaves and flowers are lurid in hue as if burnt by a tropical sun, and the tuber, in aspect much like a big turnip, is full of milk. Other things might perish in that rainless climate, but such a tuber would be preserved for many years in the dry sand.

It was a very rugged and precipitous ascent that we had to climb when we struck the Morro. In places there was no path, the rocks were sharp, and the feet of our horses were continually sliding out from under them. In spite of such obstacles we finally reached the summit, and then hobbling our steeds we sat down to rest and to look around us. The view seaward was simply magnificent. The broad Pacific stretched out in its illimitable vastness towards the west, and the coast line of sandy plains, hillocks and rocky capes, indented by beautiful bays and estuaries, could be seen for miles until it faded into haze. Around us were jagged cliffs and deep precipices descending to the sea, but to my amazement a garden of beauty clothed the few patches of soil which lodged upon the summit and in the crevices of the rocks. Here were in this savage looking place at least a score of the finest species of flowers that I had yet discovered in the Atacama. *Nolana elegans*, Ph., fairly hid the backbone of the highest ridge with its bells of blue. *Achyrophorus*, a Composite with large golden heads, adorned the lower slopes. Fine specimens of the *Calandrinia* and *Alstroemeria* already collected at the Quebada de los leones added their bright hues to this mountain park. *Loasa Urmenetæ*, Ph., ran over other plants or trailed upon the ground. A handsome *Verbena* and a little *Gilia* en-

livened the scene. Several species of *Oxalis* occurred in sandy nooks, the most curious of which was *O. gigantea*, a thick watery stemmed shrub, as high as my head, the upper part of the stalk bearing a long spike of yellow flowers arranged irregularly around the rachis. Here, too, is found the only *Tillandsia* known in the region (*T. Geisseana*, Ph.), which is, strangely enough, a cactus epiphyte. Many other interesting species besides these were added to my collection in this attractive spot, not the least valuable being six or seven rare lichens. No doubt the remarkable fertility of this rugged headland is owing to the clouds which bathe its brows with moisture every night and morning in the months of August, September and October.

I have space only to give a brief sketch of an excursion that I subsequently made by rail from Caldera to Monte Amargo, twenty-five miles inland. The engineer, a pleasant and well-informed Englishman, invited me to take a seat with him in the engine where, he said, I could survey at my leisure the road and the arid pastures on which the mules were feeding. I saw numbers of mules, it is true, and in fact, as they have a special fondness for collecting in droves upon the railroad track, we came near running over some of them, a calamity which I learned was by no means infrequent, but what the creatures could find to feed upon passed my comprehension, unless it were a very disagreeable plant that seems smeared with varnish over all its parts, and known from that fact as *Alona vernicosa*. An animal which could browse on such herbage must be quite able to relish tar, varnish and such-like substances. This plant occurs all along the railway to Monte Amargo, and bears a very pretty bright blue flower. Possibly it was the flowers that attracted the mules, as it could not have been the taste.

Monte Amargo itself is only a railway station situated in a soda swamp. In the alkaline pools around it I gathered several species of Characeæ and Naiadaceæ, and in the bogs were growing a number of saline plants such as *Salicornia* (*S. Peruviana*, HBK.), *Triglochin* and several Cyperaceæ. Through this swamp runs the Copiapo River, or rather the modicum which is left of it after being used for irrigation in the valley above. It goes no further, being here absorbed by the desert sands. Upon its

banks I saw for the first time the Chañar tree (*Gourliea Chilensis*, Clos.), a sturdy close-branched, somewhat spiny shrub, which at the time of my visit was loaded with its bright yellow flowers. This shrub yields a toothsome fruit something like a plum, that is greatly relished by man and beast. It is often dried and carried as food upon journeys. I saw old stones lying under the trees which had been gnawed into by desert rats, which are extravagantly fond of the kernel. Here, too, was a gigantic *Juncus*, its numerous thorn-pointed stalks ten feet in height and spreading in all directions like chevaux de frise. It required considerable courage to thrust the hand among these spears in search of specimens.

Out upon the open sands I came upon a flora different from any previously collected. Here I began to meet with the *Adesmias* which are so numerous on the Pacific coast. Philippi enumerates 134 species that occur in Chile alone. More than a dozen of them have been discovered in the Atacama Desert. In this locality likewise flourishes *Eritrichium gnaphaloides*, DC., which the inhabitants of the province of Copiapo call *Te del burro* or *Te del campo*, and of which they make an infusion and drink like Chinese tea. The *Acacia Cavenia* and *Lycium Chilense* stand like lonely sentinels upon the desert. Many other things rare and interesting greeted me in my wanderings over this region, but they cannot be noticed here. Of course the cosmopolitan plants, which go wherever man goes, were here to nod their familiar forms in my face. *Sonchus oleraceus*, *Solanum nigrum*, *Erigeron Canadense*, *Argemone Mexicana*, *Raphanus sativus*, *Erodium cicutarium*, *Gnaphalium purpureum*, and half a dozen other old friends were there to make me feel at home in this strange and distant land.

I was pretty well fagged out with my day's tramp when I heard the puffing of the train on its way back from Copiapo. My good friend, the engineer, was kind enough to respond to the waving of my handkerchief by stopping the cars and giving me a snug seat in the locomotive. Of my three rides none proved more enjoyable or botanically more profitable than the one on the iron horse to Monte Amargo.